

Beyond Optical Ground Terminals – How to Ensure High Quality of Service

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User Workshop on Data Formats for Optical LEO Downlinks
Nov. 10, 2016



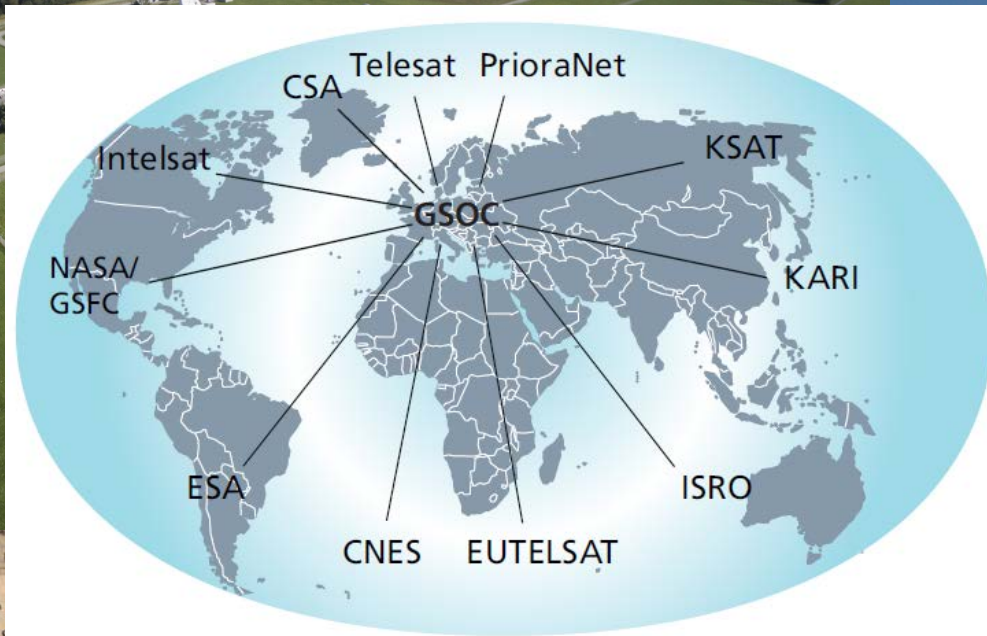
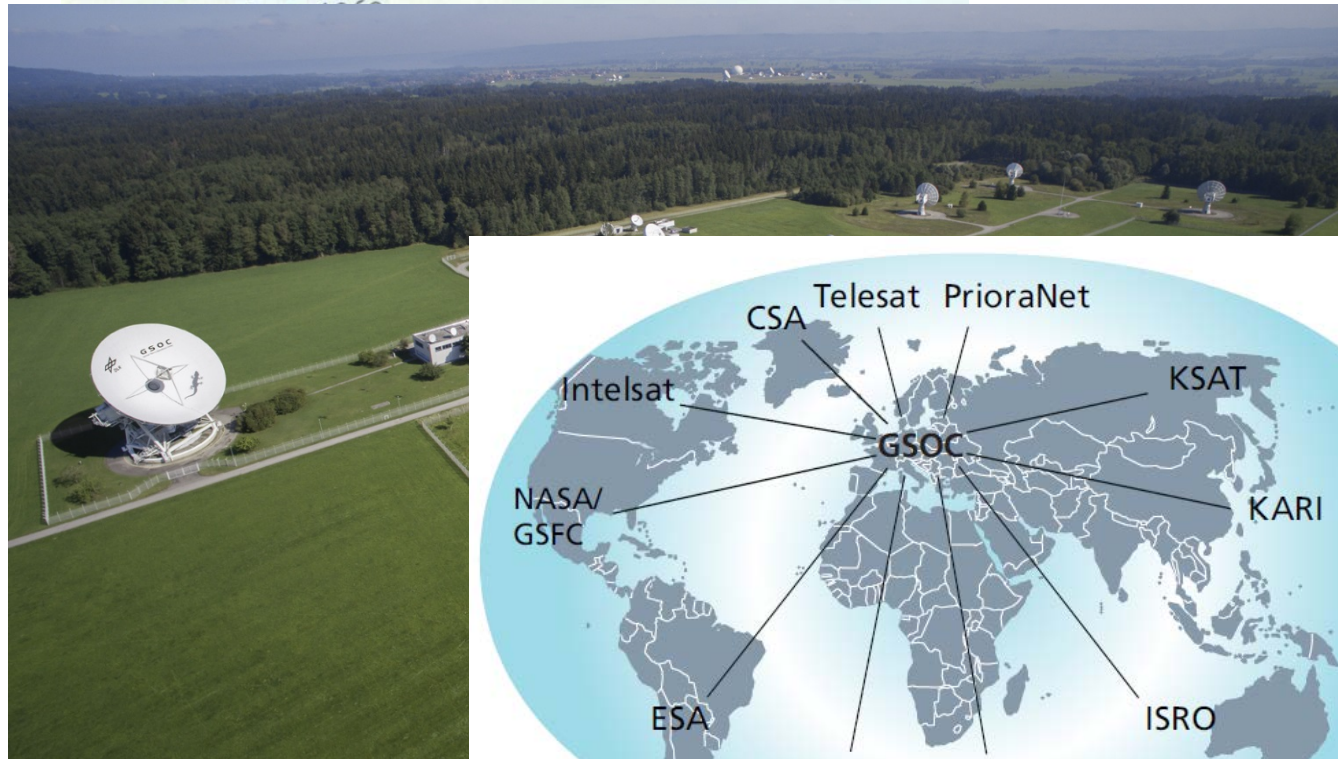
Outline

- Quality of Service – Lessons Learned from
 - 50 Years of Ground Operations at the Station Complex Weilheim
 - Operations of the Interconnection Ground Sub Network (IGS)
- Description of the Problem and Parameter Space
- Potential Attempt at a Solution
- Out of Band Forward Tasking
- Implications on Ground Operations



50 Years Station Complex Weilheim

Weilheimer Tagblatt

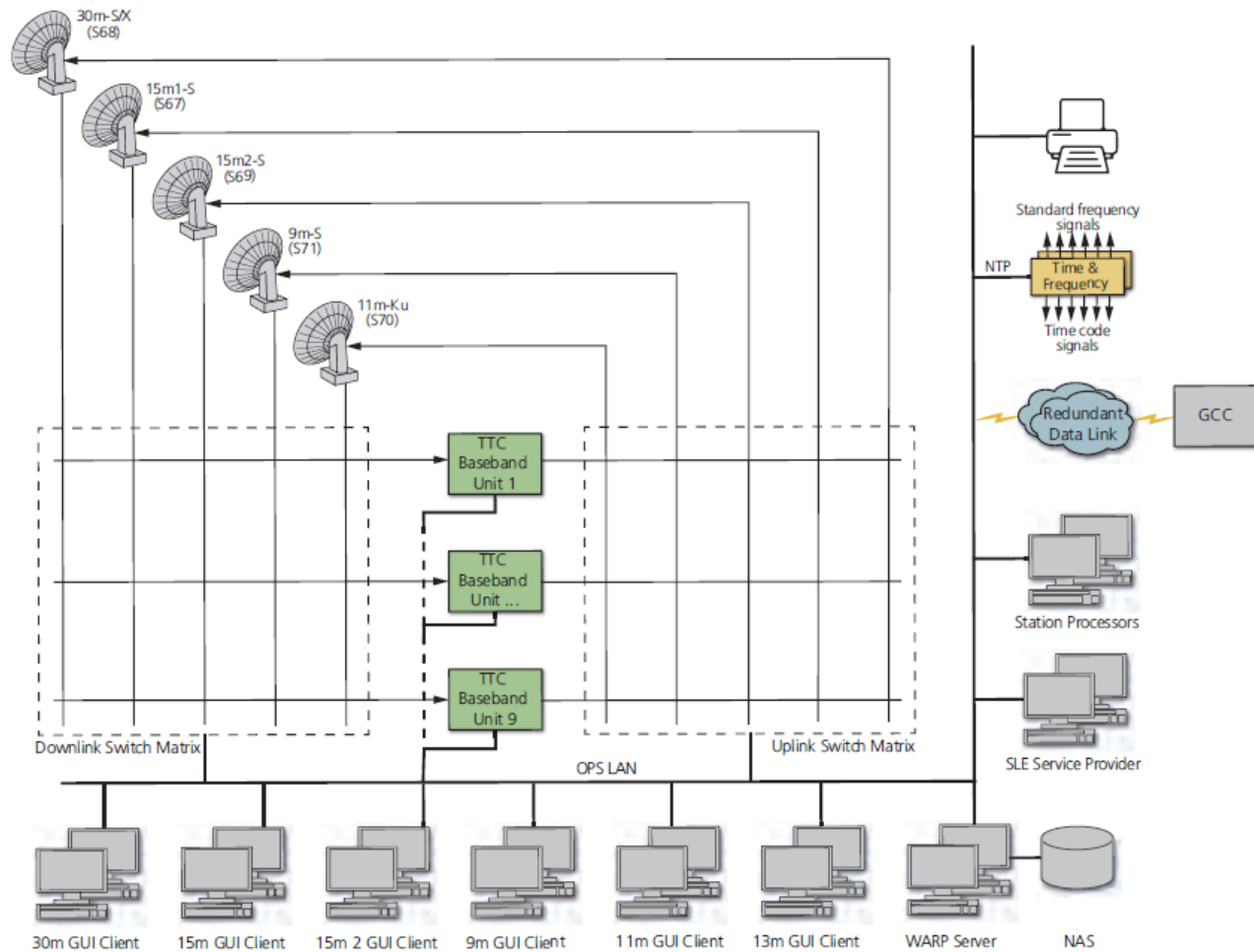


EIN RICHTBAUM ZIERT
die TC-Antenne in der Lichtenau. Sie
wird später einmal für Kommandosignale
an den Satelliten dienen.

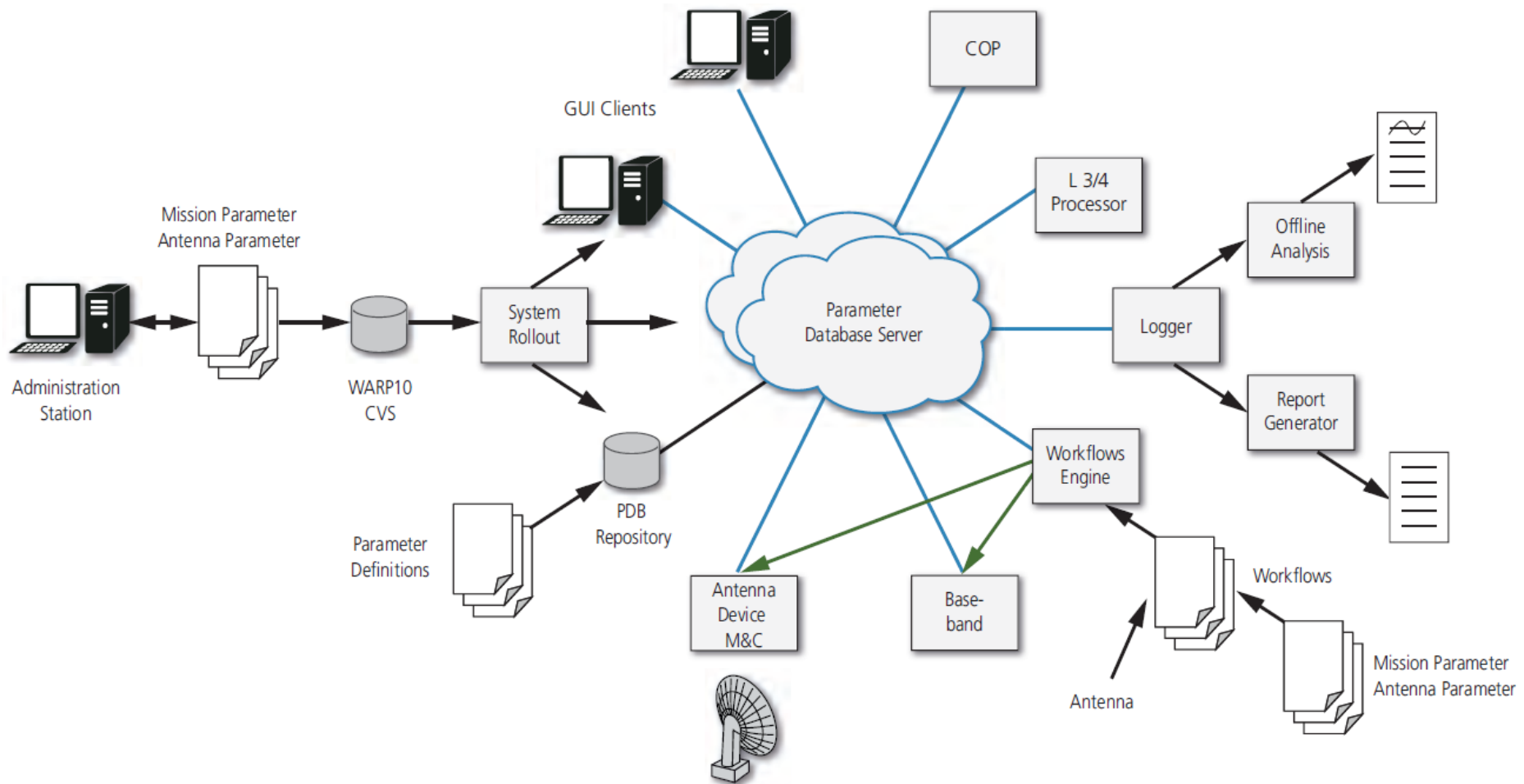
zu erkennen.



Ground Station Subsystems



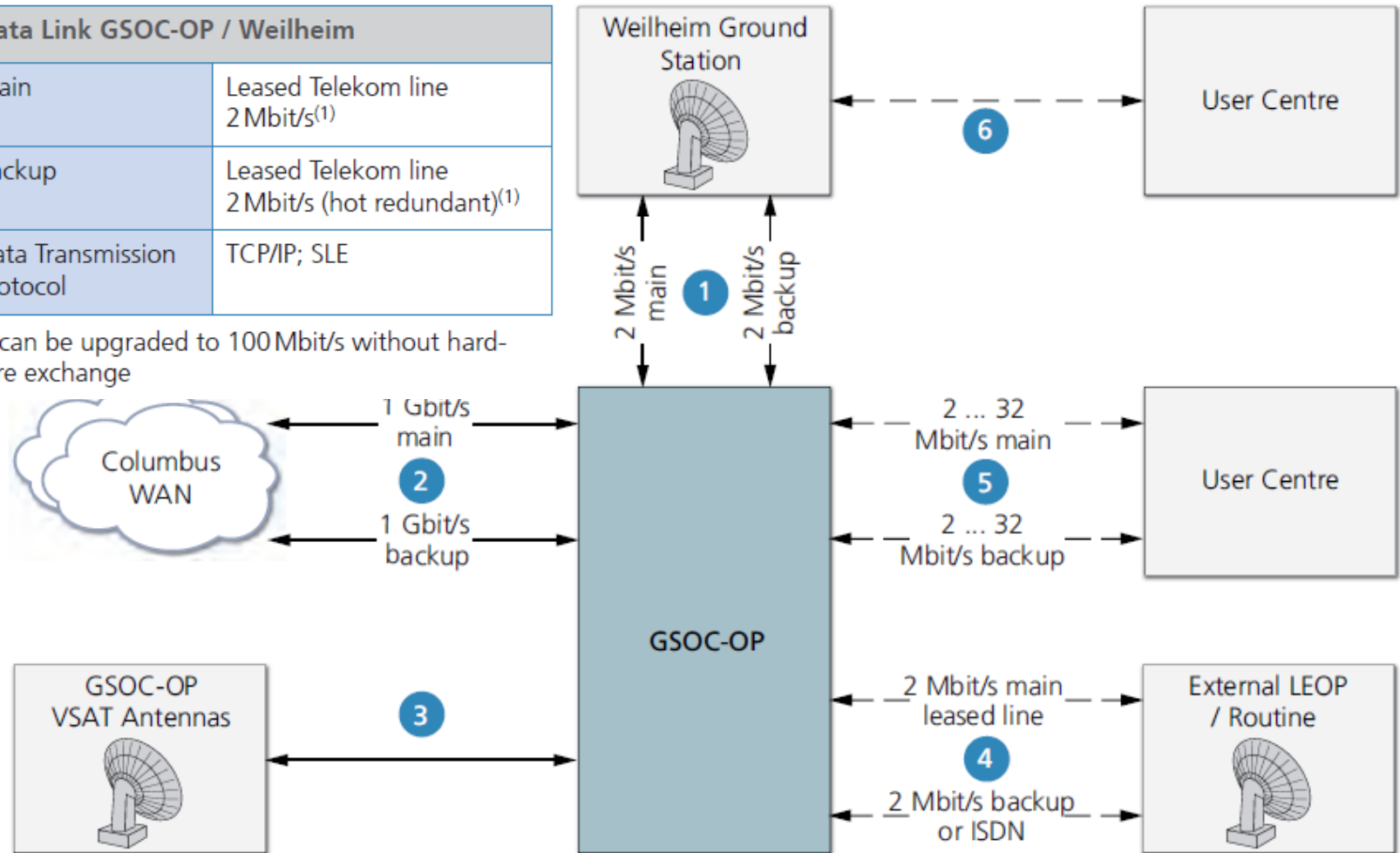
The M&C Subsystem WARP10



Communications Infrastructure

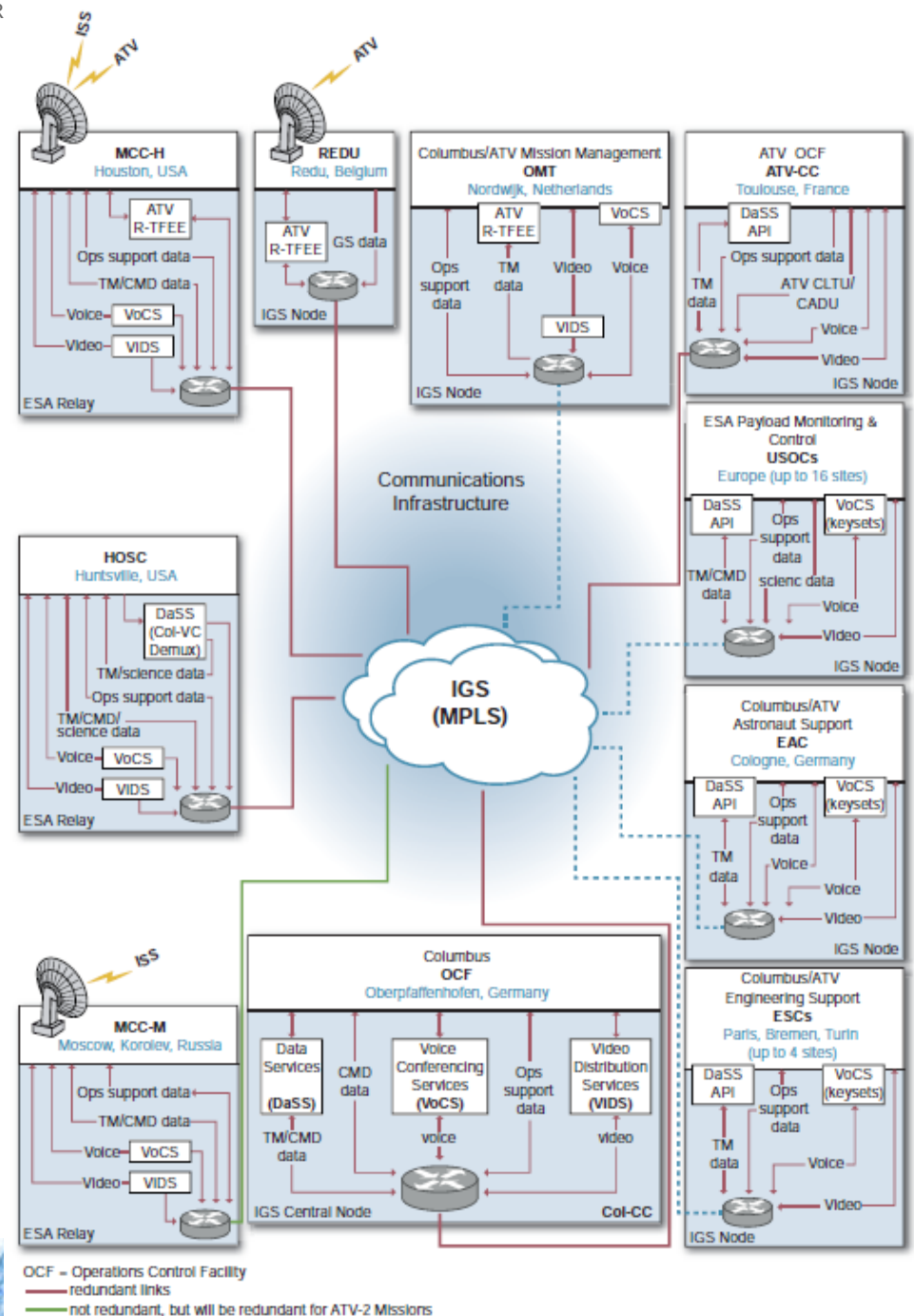
Data Link GSOC-OP / Weilheim	
Main	Leased Telekom line 2 Mbit/s ⁽¹⁾
Backup	Leased Telekom line 2 Mbit/s (hot redundant) ⁽¹⁾
Data Transmission Protocol	TCP/IP; SLE

(1) can be upgraded to 100 Mbit/s without hardware exchange



Columbus Network

- Main relays (MCC-H, MCC-M, HOSC and ATV-CC) are nearly 100 % redundant.
- Col-CC has full node redundancy.
- Bandwidth: varies from 10 Mbit/s to 100 Mbit/s; Col-CC has 1 Gbit/s

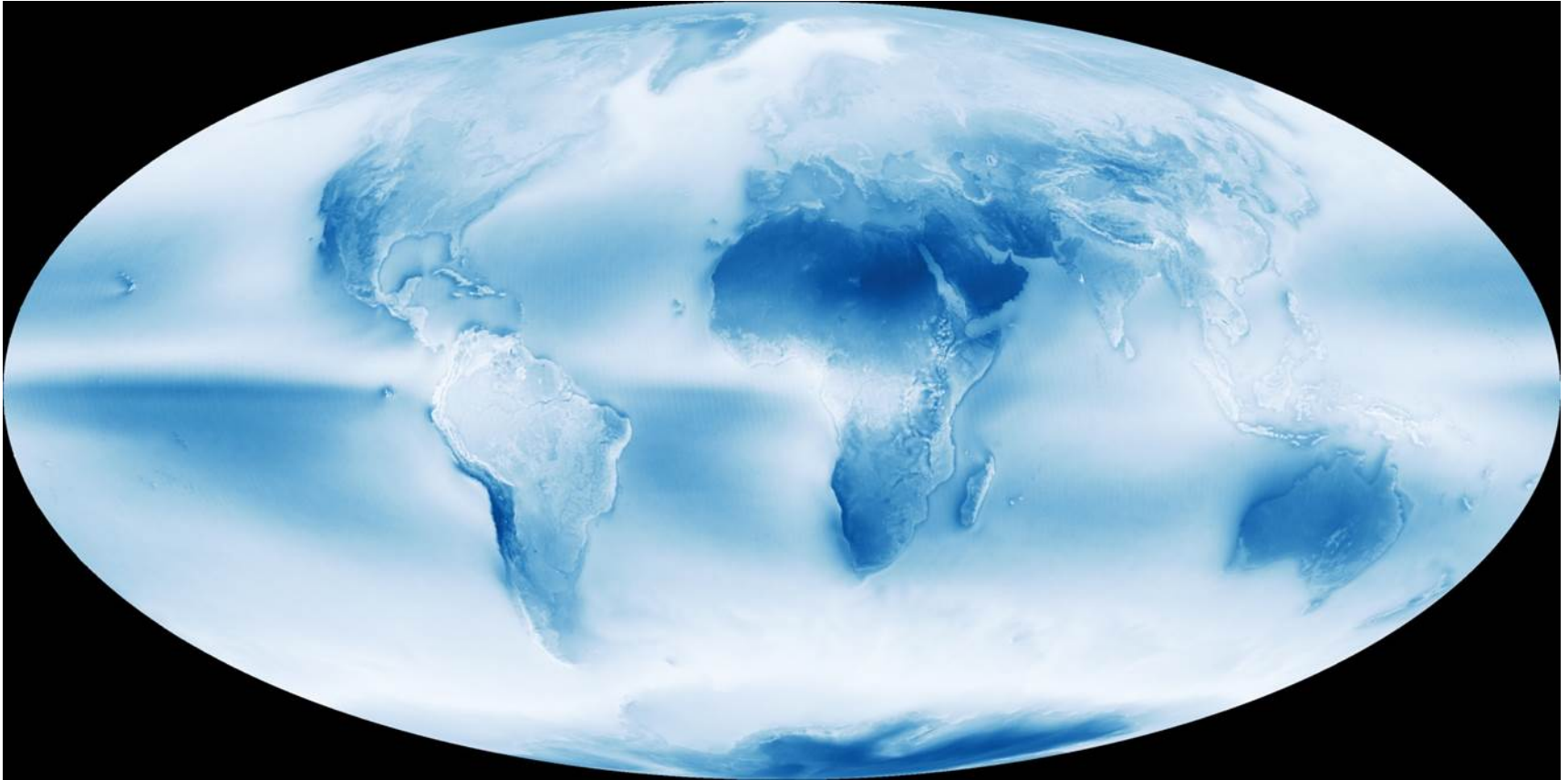


Demanding Quality of Service in TM/TC Business

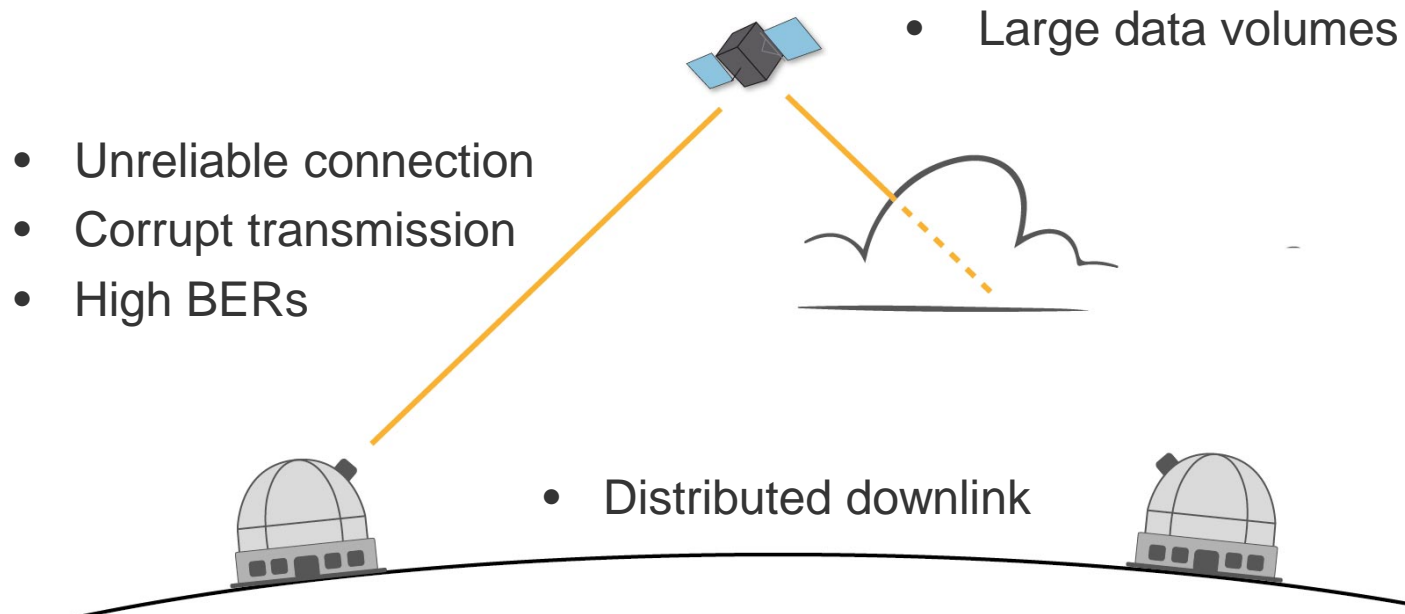
- High Link **Availability**
- **Fast Response** to Contingencies
- **Redundancy** of Essential Infrastructure Elements
- High Order of **Automation**



How Does This Relate to OLEODLs?



How Does This Relate to OLEODLs?

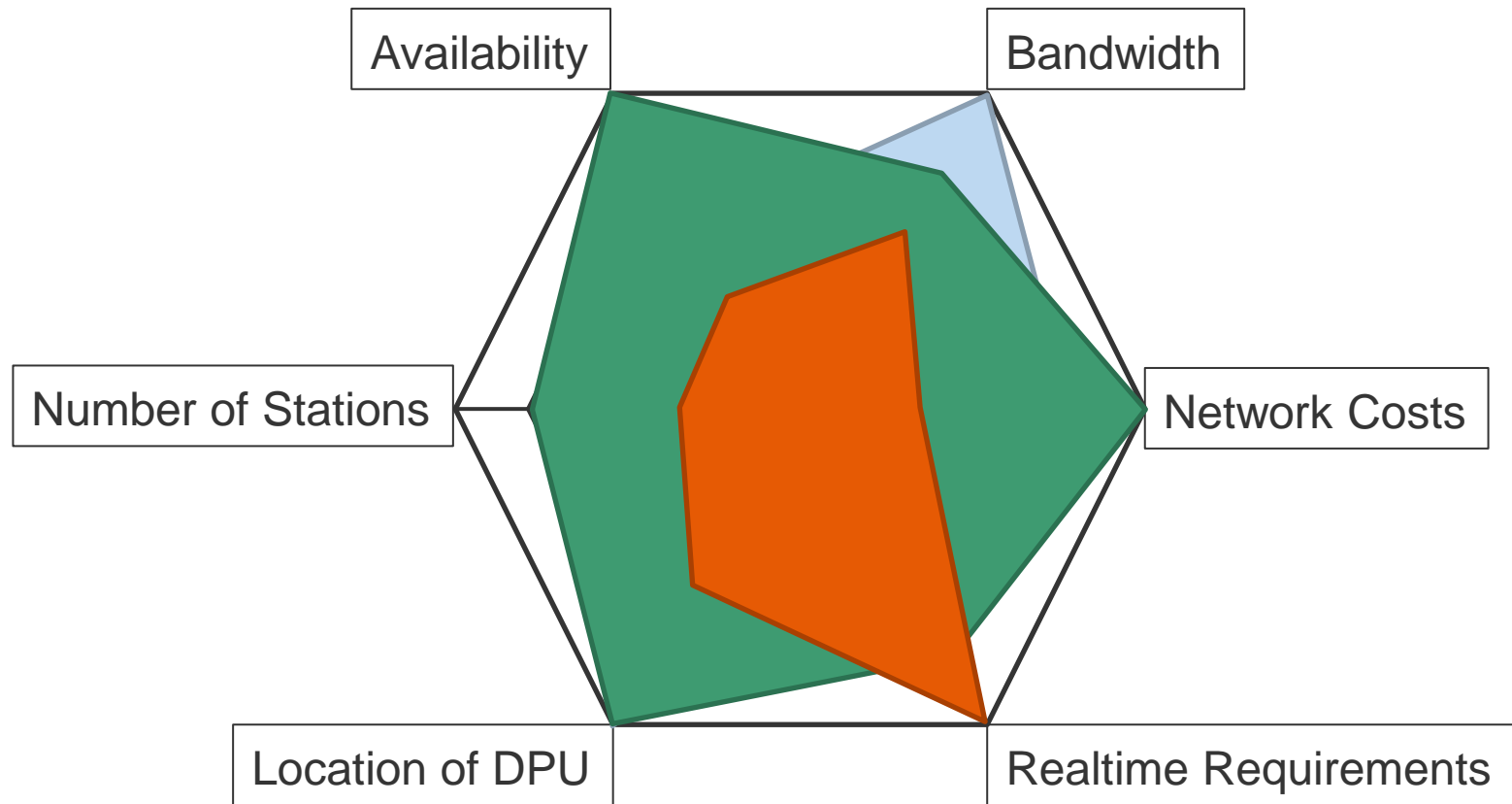


OGS Network required to overcome limited availability due to clouds

- High degree of complexity
- Highly dynamic
- Project specific topologies to be taken into account



Parameter Space (Suggestion)



How to Solve This?

The right **strategies** are essential!

- Data Dump
- Data Storage
- Data Re-Assembly

- Error Correction of Fragmented Data

- Collection of Site-Specific Weather Data
- Analysis of Station Uptime
 - Timing is a main concern
 - Complexity scales with number of stations involved



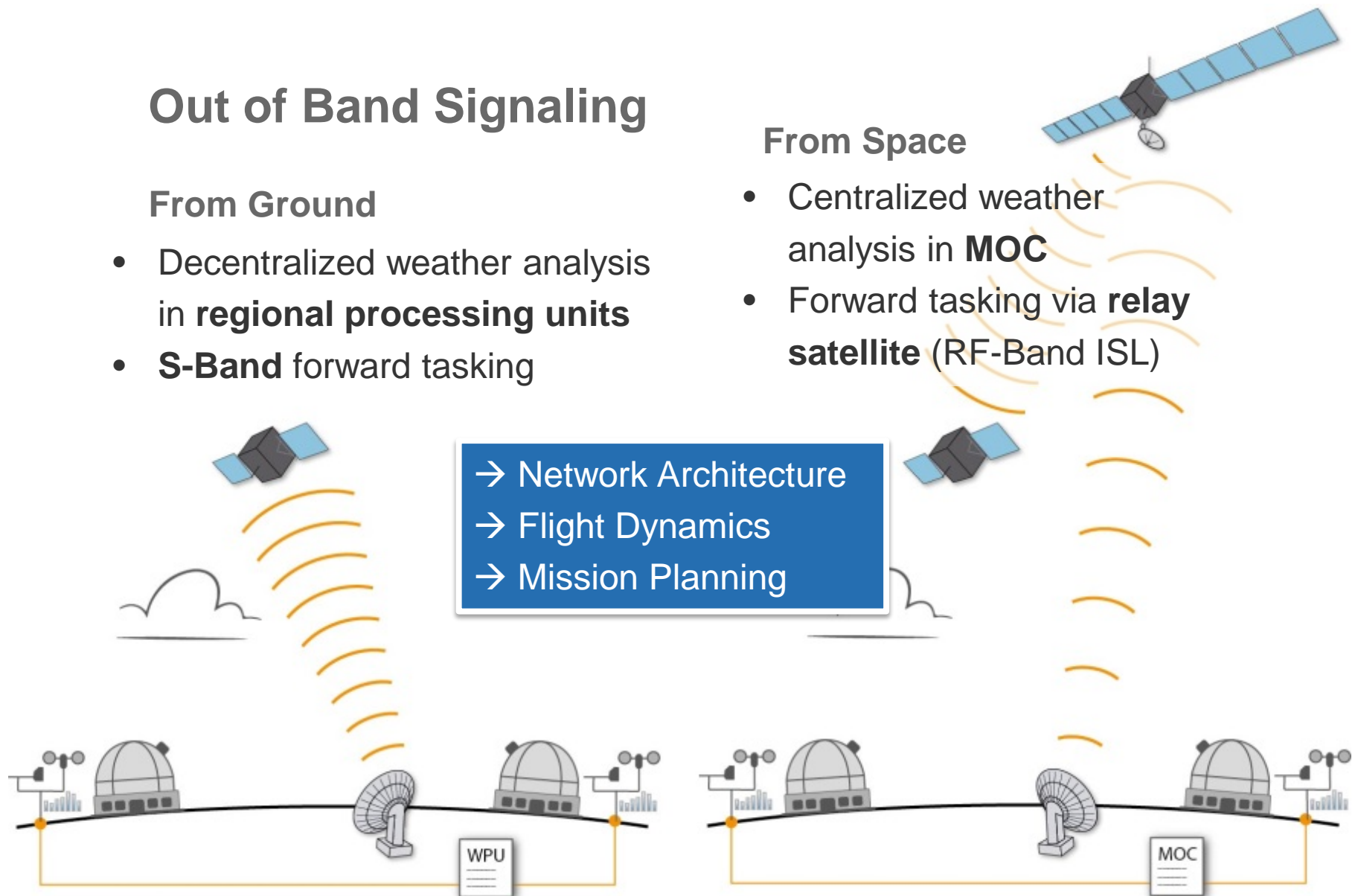
Out of Band Signaling

From Ground

- Decentralized weather analysis in **regional processing units**
- **S-Band** forward tasking

From Space

- Centralized weather analysis in **MOC**
- Forward tasking via **relay satellite** (RF-Band ISL)



Impacts on Ground Operations

Focus on the **development and optimization** of:

- Automated Systems
- Strategies
- Monitoring (24/7)
- Maintenance
- Obsolescence



Thank you for your Attention!

